

1. For the input admittance $y(s) = \frac{3s^2+5s+6}{10s^2+10s+10}$ create a set of semistate equations which yield it. Check that you do obtain $y(s)$. Repeat on $y(s) = \frac{3s^2+5s+6}{10s^2+10s+10} \cdot \frac{2s+8}{s^2+as+1}$ for different values of real a ; consider especially $a=1$ and $a=2$.
2. Synthesize the first $y(s)$ of 1. above from the semistate equations.
3. Set up semistate equations to for $y(s) = 3s^3+2s^2+s+10$ and then give a realization from the semistate equations using capacitors and VCCSs. Discuss the end result in terms of passivity, minimum number of dynamical elements (capacitors) and practicality. Extend the result to $y(s) = \sum_{i=0}^n a_i s^i$ for any positive n and real a_i .
4. Devise a means of realizing a scalar current transfer function $T(s) = i_2/i_1$ from its semistate equations. Carry this out on $T(s) = \frac{3s^2+5s+6}{10s^2+10s+10}$. Repeat if $T(s)$ is a voltage transfer function.
5. (much harder) Set up a means to obtain semistate equations from an $n \times m$ matrix transfer function $T(s)$. Then give a synthesis of $T(s)$ from the semistate equations for inputs u and outputs y being either currents or voltages. For this consider placing all dynamics in capacitors and check if your scheme uses a minimum number of capacitors.
6. (also hard) If $y(s)$ is a positive real scalar determine transformations on the semistate which lead to a passive realization. Try this out on some positive real functions, for example (5) and (6) of Example 8.2-1, p. 340, of the text.